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LED DISPLAY UNIT
[LED hyoujiki]

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[Claims] /2*

[Claim 1] With respect to an LED display unit 1 that is equipped with at least one display module group 10, in which many LED elements, 11a … 11a, are arranged in an LED light-emitting part 11 and in which a display memory 12 used for the display information is provided, and that forms a series of optical image groups on the display screen while scrolling the display screen,

an LED display unit characterized by: the display module 10 being provided with a buffer memory 13 for moving the storage position of the display information in a set direction; the buffer memory 13 being provided with an information introducing end on the display control part 12 side; an information input/output end being provided on the display memory 12 side; the information introducing end being connected to the display control part 20; and the information input/output end being connected to the display memory 12.

[Claim 2] An LED display unit defined in Claim 1, characterized by the display module 10 being composed of multiple levels, the buffer memory 13 of one display module 10 being connected to the information transmitting end of the display control part 20, and the other buffer memories 13 being multilevel-connected to a series of serial architectures.

[Claim 3] An LED display unit defined in either one of Claim 1

* Numbers in the margin indicate pagination in the foreign text.

or 2, characterized by: the buffer memory 13 being composed of a shift register comprised of a serial data input end, serial data output end, and parallel data input/output end; the input end being connected to the display control part 20; and the input/output end being connected to the display memory 12.

[Claim 4] An LED display unit defined in any one of Claim 1, 2, or 3, characterized by: the buffer memory 13 being composed of a shift register comprised of a serial data shift instruction introducing end and a parallel data read-back instruction introducing end; and the shift instruction introducing end and read-back instruction introducing end being connected to the display control part 20.

[Detailed Description of the Invention]

[0001] [Technical Field of the Invention]

The present invention relates to an LED display unit that continuously displays a series of display information while scrolling the display screen.

[0002] [Related Art of the Invention]

Conventionally, LED display units have been widely utilized for electrical bulletin boards, etc., and are installed in high-traffic areas to provide the passersby with various types of guidance information. For example, they can be utilized for various purposes by being installed on external walls of buildings to display news, utilized for official bulletins of public buildings, such as city

offices, and utilized for usage guides at airports and stations.

[0003] Figure 4 is a drawing for explaining the LED display unit of one conventional example. As illustrated in Figure 4, this LED display unit 100 is equipped with multiple groups of display modules, 110 … 110, as well as a display control part 120 which is for systematically controlling the display functions of the display modules, 110 … 110. Each display module 110 is provided with an LED light-emitting part 11, in which many LED elements, 11a … 11a, are arranged in a matrix manner, and a display memory 112, which is used for their display information, and a series of display information is transferred from the display control part 120 to the display memory 12 via a buffer memory 113.

[0004] Figure 5 is a drawing for explaining the display screen of the LED light-emitting part illustrated in Figure 4. (a) illustrates the screen shown at a specific point in time, and (b) illustrates the screen shown at the point in time that follows. As shown in Figure 5, one display screen is shared by multiple LED light-emitting parts, 11 … 11, and a series of optical image groups are sequentially displayed while the divided screens (nine screens in Figure 5) are scrolled from right to left in terms of the drawing surface. For this reason, it is possible to swiftly display urgent guidance information by utilizing large letters, patterns, etc., clearly discernible by incoming and outgoing passengers from afar without having to enlarge the light-emitting surface of the single

LED light-emitting part 11.

[0005] [Problems that the Invention is to Solve]

However, since the amount of information that can be transferred at one sitting from the display control part is limited in the LED display unit of the above conventional example, transferring all of the display information for one static screen requires that the information be divided into many pieces and be transferred repeatedly in limited amounts. Furthermore, since many static screens need to be formed repeatedly in accordance with the scrolling of the display screen, it takes a long time for a single piece of display information to finish being displayed, and this has a problem in that urgent guides cannot be displayed swiftly.

[0006] Moreover, since increasing each transfer amount of the display information requires an expensive control device for the display control part capable of transferring information at a high rate, the display control part ends up being comparatively high in price. In addition to this problem, increasing the number of signal lines that run from the display control part to buffer memory or increasing the input/output circuits inside the display control part complicates the circuits, resulting in an increase in the overall failure rate. Therefore, removal of these problems has been a critical issue.

[0007] In light of this, the aim of the invention for solving the above problems is to supply an LED display unit capable of

shortening the processing time required for scrolling.

[0008] [Means for Solving the Problems]

With respect to an LED display unit that is equipped with at least one display module group, in which many LED elements are arranged in an LED light-emitting part and in which a display memory used for the display information is provided, and that forms a series of optical image groups on the display screen while scrolling the display screen, an LED display unit supplied by the invention to accomplish the above aim is characterized by: the display module being provided with a buffer memory for moving the storage position /3 of the display information in a set direction; the buffer memory being provided with an information introducing end on the display control part side; an information input/output end being provided on the display memory side; the information introducing end being connected to the display control part; and the information input/output end being connected to the display memory.

[0009] According to the LED display unit of the invention, display information is transferred from the display control part to the display memory by means of a buffer memory, this display information is read back from the display memory to be shifted in a set direction, and [this display information] can be sent back to the display memory after having added to it new display information in the amount that corresponds to the shift. Therefore, by allowing the display control part to sequentially repeat transferring, reading,

shifting, and retransmitting the display information with respect to the buffer memory, a series of optical image groups can be continuously formed on the display screen while scrolling the display screen.

[0010] An LED display unit defined in Claim 2 of the invention is characterized by the display module being composed of multiple levels, the buffer memory of one display module being connected to the information transmitting end of the display control part, and the other buffer memories being multilevel-connected to a series of serial architectures.

[0011] As a result, display information of an arbitrary length can be utilized.

[0012] An LED display unit defined in Claim 3 of the invention is characterized by: the buffer memory being composed of a shift register comprised of a serial data input end, a serial data output end, and parallel data input/output end; the input end being connected to the display control part; and the input/output end being connected to the display memory.

[0013] An LED display unit defined in Claim 4 of the invention is characterized by: the buffer memory being composed of a shift register comprised of a serial data shift instruction introducing end and a parallel data read-back instruction introducing end; and the shift instruction introducing end and read-back instruction introducing end being connected to the display control part.

[0014] These can be connected to common display control parts and display memories.

[0015] [Embodiment of the Invention]

In the following, an embodiment of the invention will be described with reference to the accompanying drawings. Figure 1 is a block diagram for explaining one embodiment of the invention. As illustrated in Figure 1, the LED display unit 1 of this embodiment is equipped with multiple display modules, 10 … 10, used for the display information and a display control part 20 for each of these display modules 10.

[0016] This LED display unit 1 is suitable for installation in, for example, a public transportation facility or the like and for displaying the information, etc., of the trains that pass, arrive at, or depart from the station to the incoming and outgoing passengers. In that case, various types of guidance information can be displayed instantaneously from a distant centralized administration office or the like by means of remote control.

[0017] The abovementioned display control part 20 is equipped with an MPU, such as a commonly known microcontroller or the like and with a peripheral circuit, such as a work memory for retaining status information. Moreover, a control memory 30 for storing and preserving a display control program is also equipped. Each connecting end of the display modules, 10 … 10, of the display control part 20 is connected to a signal line 13b for serial data as well as to a group

of various control lines 21. Also, the connecting end on the external side is connected to a group of communication lines 22, which are used for controlling the display from a remote location. This group of communication lines 22 include a display information transmitting line, display operation selection line, etc.

[0018] The abovementioned display module 10 is provided with an LED light-emitting part 11, which is for forming optical images in accordance with display information, provided to its front surface. This LED light-emitting part 11 has many LED elements, 11a … 11a, arranged in a matrix manner on a substrate, and the combination of illuminated and non-illuminated LED elements, 31a … 31a, forms an optical image composed of letters, numbers, graphics, etc. A display memory 12 used for display information that corresponds to the optical image is installed behind the LED light-emitting part 11 and is connected to the display control part 20 via the group of various control lines 21.

[0019] Figure 2 is a magnified drawing of the essential part of the display module illustrated in Figure 1. As also illustrated in Figure 2, this display memory 12 has many addresses, 12a … 12a, which are for storing parallel data by means of a writable/readable RAM. The abovementioned optical image is expressed by the display information stored in the multiple addresses, 12a … 12a.

[0020] The address selecting part 12b of the display memory 12 has connected to it an address bus 21a, which is for specifying the

individual addresses 12a, as well as a writable/readable control line 21b, which is for instructing to write into, or read from, each address 12a to. Additionally equipping a separate write control line and read control line to this write/read control line 21b makes it possible to use a common, inexpensive RAM.

[0021] In addition to these, each of the display memories, 12 ... 12, is connected to various types of control lines, such as an address or data latch enable [control line], device selection [control line], clock [control line], etc., but since all of these are commonly known techniques, their detailed descriptions will be omitted.

[0022] The parallel data input/output part 12c of the display memory 12 is also equipped with a buffer memory 13, which is for transferring display information from the display control part 20 to the display memory 12, and is connected to the parallel data input/output end of this buffer memory 13 via a parallel-data-type bidirectional signal line group 13a. As this buffer memory 13, a one-word shift register 33, which operates in accordance with the parallel data display information, is utilized. The serial data input end of the buffer memory 13 is connected to the above-described serial data signal line 13b.

[0023] The serial data output end of the buffer memory 13 is connected to the serial data input end of the buffer memory 13 of the next level through another serial data signal line 13b, and /4

thereafter, all of the buffer memories, 13 … 13, are series-connected sequentially to form a multilevel structure. This makes it possible to transfer display information of arbitrary lengths in a serial format and to simultaneously display even a comparatively long sentence composed of multiple letters or graphics by means of a single LED display unit 1.

[0024] The shift instruction introducing end of the buffer memory 13 is connected to the shift control line 21c of the shift register, and the read-back instruction introducing end of the buffer memory 13 is connected to a parallel-data write control line 21d. These address bus 21a and write control line 21b of the display memory 12 are arranged in a manner such that they are led out of the abovementioned display control part 20 and drawn into the display memory 12 of the next level through the display memory 12.

[0025] Moreover, the abovementioned one signal line 13b of the buffer memory 13, shift control line 21c, and write control line 21d are connected to the buffer memory 13 of the next level through the buffer memory 13 in the same manner.

[0026] Next, the operation of the present embodiment will be explained. Figure 3 is the flowchart for the display process carried out by the display control part illustrated in Figure 2. (a) illustrates the process for the initial display in the initial condition, and (b) illustrates the process for the scroll display carried out by means of scrolling that follows. According to the

initial display process illustrated in (a) of Figure 3, the display information is first set in the buffer memory 13 (step 11). In addition, it will be assumed that a specific display operation has been selected by a remote central administration desk in advance.

[0027] An optical image, such as a letter, number, symbol, simple graphic form, etc., generally has a matrix structure consisting of 16 vertical and horizontal bits. Therefore, to display a sentence containing multiple letters, etc., arranged in a single horizontal line, each display screen is constructed of 16 bits (e.g., 16 LED elements, 11a … 11a) in the vertical direction and 16 bits in the horizontal direction multiplied by the number of letters. For this reason, 16-bit data that makes up the initial part of the one-dot horizontal line of the optical image is utilized as the display information.

[0028] In the abovementioned step 11, the first display information is first converted to the serial data format by the display control part 20 and is transmitted to the buffer memory 13 through the abovementioned one signal line 13b. At the same time, a first shift operation instruction is transmitted to the buffer memory 13 via the shift control line 21c.

[0029] When this first shift operation instruction is transmitted continuously for at least the period that corresponds to the length of the first display information, the display information of the first serial data is introduced, sequentially from the first

portion, into the shift register of the buffer memory 13, and the last portion then reaches the serial data output end of the buffer memory 13.

[0030] Next, after the display information pieces are continually and sequentially sent into the shift register of the buffer memory 13, the initial display information is pushed out to the buffer memory 13 of the next level through this buffer memory 13. For this reason, it is not necessary to set the length of each shift register in a manner such that the first part of each display information piece always reaches the last level (last bit) of the shift register.

[0031] After all of the buffer memories, 13 ... 13, of the multilevel structure have been filled with corresponding display information as a result of the above continuous feeding of multiple display information pieces, these display information pieces subsequently become stored in the display memory 12 (step 12).

[0032] In this step 12, the initial address of each display memory 12 is first specified through the abovementioned address bus 21a, and at the same time, a write instruction is transmitted to each display memory 12 through the abovementioned write control line 21b. Then, the specified address 12a of each display memory 12 is accessed via the abovementioned parallel-data-format signal line group 13a, and the display information of each buffer memory 13 is stored at once.

[0033] As a result of this storing in each display memory 12, the first one-dot horizontal line of the optical image shown on the list is constructed on the display memory 12. Next, it is judged whether or not the currently specified address 12a is the last address 12a of the display memory 12 (step 13). If the last address 12a has not been reached yet, the process of the above step 11 through step 13 is repeated.

[0034] If the currently accessed address 12a has already reached the last address 12a, it indicates that all of the dot lines of the optical image have been stored in the display memories, 12 … 12. As a result, each LED light-emitting part 11 is driven (step 14).

[0035] In this step 14, the display control part 20 transmits a drive instruction to each LED light-emitting part 11 through a control line not shown, and the first optical image is displayed based on the display information of the display memory 12. As a result, the first display screen is generated in the present LED display unit 1, and the sentence or the like of the initial part of a series of guidance information is presented to incoming and outgoing passengers.

[0036] Next, the scrolling process will be described. As illustrated in (b) of Figure 3, reading display information back from the display memory 12 is the first step in this scrolling process (step 21).

[0037] In this step 21, the display control part 20 specifies

the first address 12a of each display memory 12 through the abovementioned address bus 21a first, and at the same time, a read instruction is transmitted to each display memory 12 via the write/read control line 21b. Next, a parallel-data write instruction is transmitted to the buffer memory 13 through the write control line 21d of the buffer memory 13. As a result, the first display /5
information of the display memory 12 is read back into the buffer memory 13 through the data input/output part 12c of each display memory 12.

[0038] Next, the display information read back into the buffer memory 13 is updated (step 22). In this step 21, a second shift operation instruction is first transmitted by the display control part 20 to each buffer memory 13 via the shift control line 21c, and the display information that was read back is shifted by one bit in the direction of the next level inside the shift register of the buffer memory 13, and its last part is shifted from the serial data input end of the buffer memory 13 to the interior.

[0039] At the same time, the display control part 20 sends 1 bit of new display information to the serial data input end via the abovementioned one signal line 13b, and as a result, the display information inside the buffer memory 13 is updated to the next display information which has been combined with the above 1 bit [of display information].

[0040] Next, the same process as the above-described storing

(step 12) in the display memory 12 is carried out (step 23), and the updated display information is stored at once in the first address 12a of each display memory 12 as the first horizontal dot line of the new optical image.

[0041] Then, the same process as the above-described judging of the address 12a (step 13) is carried out (step 24), and if the currently accessed address 12a has not yet reached the last address 12a, the process of the above-described steps, 21 - 24, is repeated.

[0042] On the other hand, if the last address 12a has already been reached, the same process as the above-described displaying in the LED light-emitting part 11 (step 14) is carried out (step 25), and an optical image that corresponds to the new display information in the display memory 12 is displayed in each LED light-emitting part 11. As a result, the above-described first display screen is scrolled by one bit, a new display screen is generated in the LED display unit 1, and the part that follows the above-described sentence or the like is presented to the incoming/outgoing passengers.

[0043] In this manner, repeating the scrolling process as described above makes it unnecessary to transmit all display information of each display screen from the display control part 20 to the buffer memory 13 every time. Therefore, from the second time and thereafter, the sentence, etc., of the guidance information can be swiftly displayed to the end by forming new display information on the buffer memory 13 in a short amount of time and by scrolling the

display screen of the present LED display unit 1.

[0044] [Effects of the Invention]

As explained in the above, the present invention can supply an LED display unit capable of shortening the processing time required for scrolling since it can continuously display a series of display information, while scrolling the display screen, by causing the buffer memory to repeat transferring, reading back, shifting, and re-transmitting the display information.

[Brief Explanation of the Drawings]

[Figure 1] A block diagram for explaining one embodiment of the invention.

[Figure 2] A magnified view of the essential part of the display module illustrated in Figure 1.

[Figure 3] The flowchart of the display process carried out by the display control part illustrated in Figure 2.

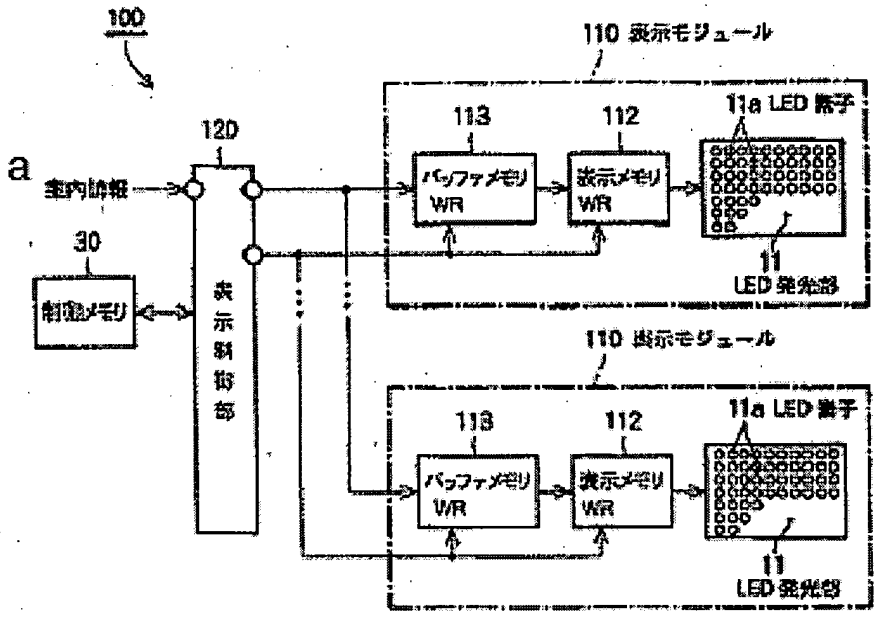
[Figure 4] A drawing for explaining one example of the LED display unit of the conventional example.

[Figure 5] A drawing for explaining the display screen of the LED light-emitting part 11 illustrated in Figure 4.

[Description of the Reference Numerals]

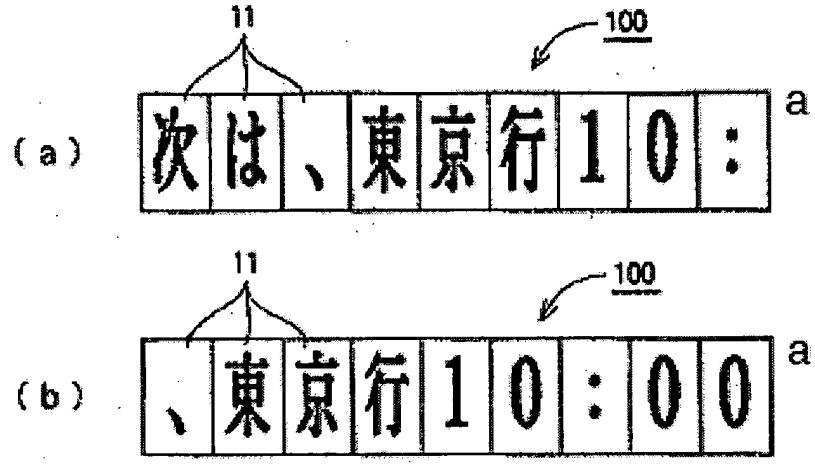
1, 100 = LED display unit; 10, 100 = display module; 11 = LED light-emitting part; 11a = LED element; 12, 112 = display memory; 12, 113 = buffer memory; 13b = signal line; 20, 120 = display control part; 21 = control line; 22 = communication line; 30 = control memory.

[Figure 4]



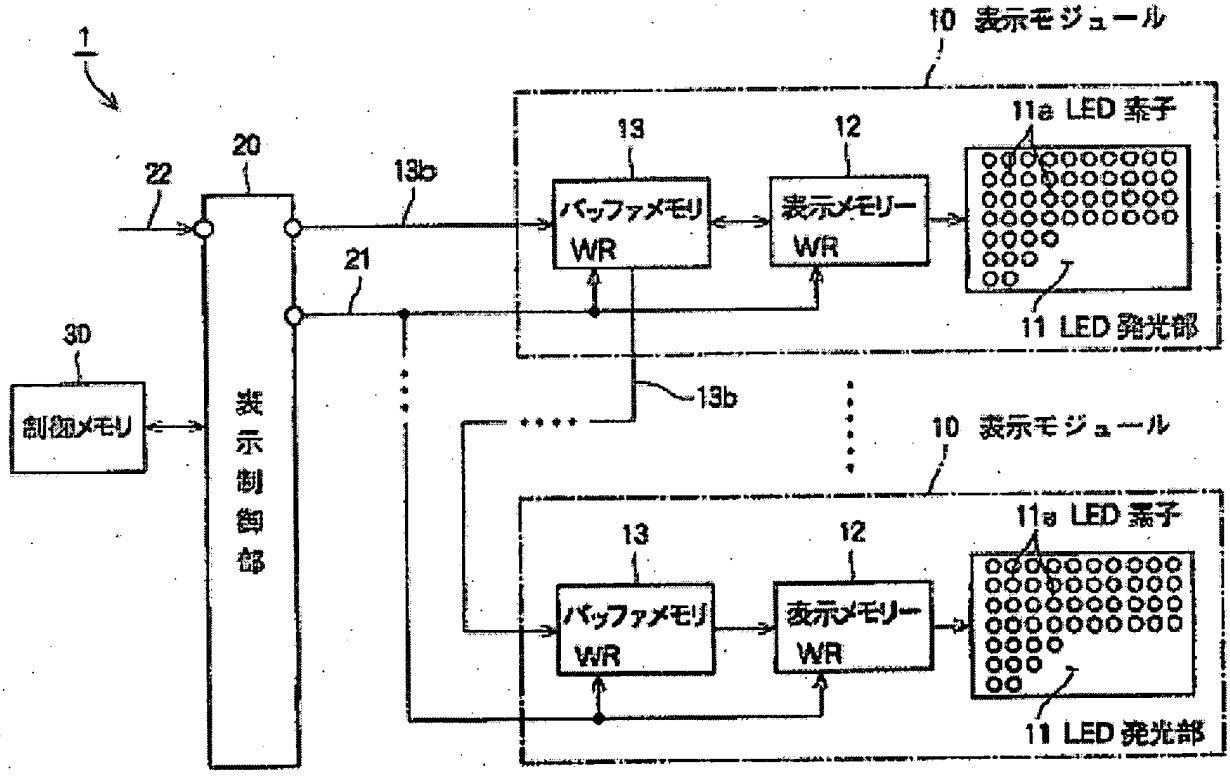
Key: a) Guidance information; 11) LED light-emitting part; 11a) LED element; 30) Control memory; 110) Display module; 112) Display memory WR; 113) Buffer memory WR; 120) Display control part.

[Figure 5]



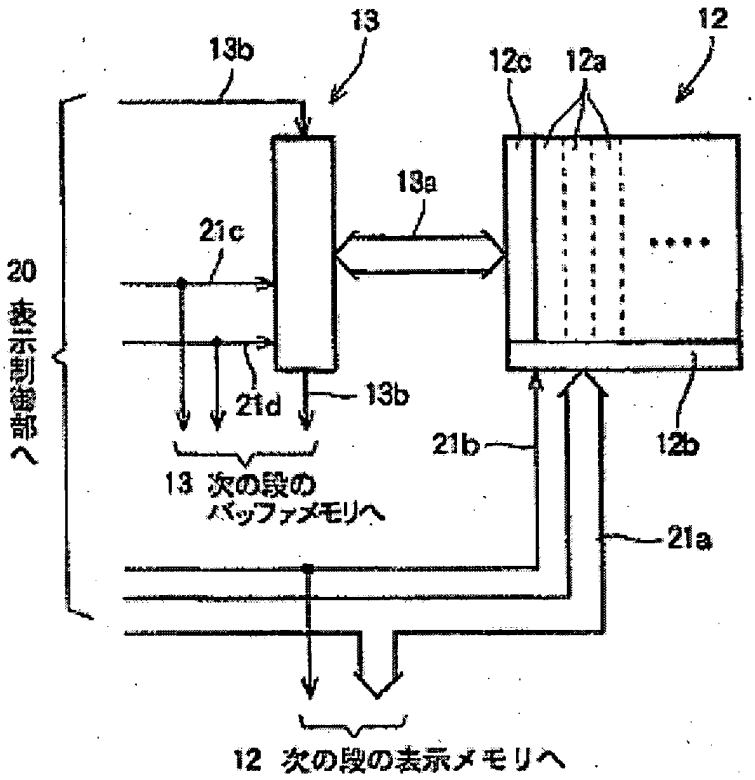
Key: a) Next destination, Tokyo, 10:00.

[Figure 1] /6



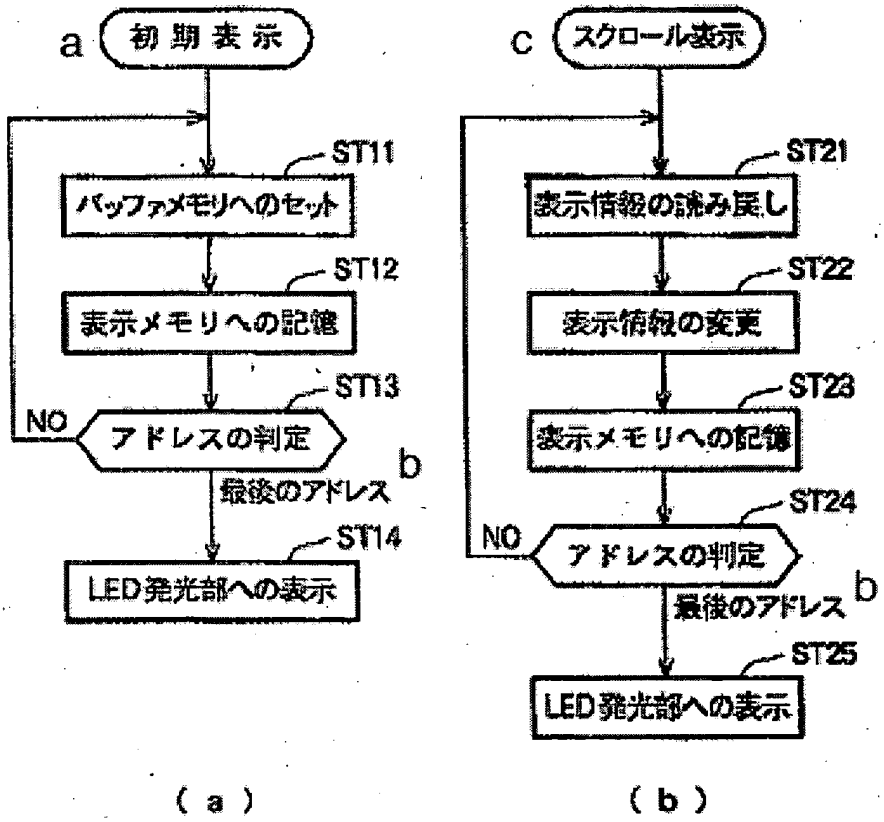
Key: 10) Display module; 11) LED light-emitting part; 11a) LED element; 12) Display memory WR; 13) Buffer memory WR; 20) Display control part; 30) Control memory.

[Figure 2]



Key: 12) To the display memory of the next level; 13) To the buffer memory of the next level; 20) To the display control part.

[Figure 3]



(a) (b)

Key: a) Initial display; b) Last address; c) Scrolling; ST11) Set in buffer memory; ST12) Stored in display memory; ST13) Address judged; ST14) Display in LED light-emitting part; ST21) Display information read back; ST22) Display information updated; ST23) Stored in display memory; ST24) Address judged; ST25) Display in LED light-emitting part.